

*A PRACTICAL VARIATION OF A MULTIPLE-SCHEDULE PROCEDURE:  
BRIEF SCHEDULE-CORRELATED STIMULI*

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Multiple schedules using continuous discriminative stimuli have been used to minimize children's disruptive requesting for teacher attention (e.g., colored floral leis; Tiger & Hanley, 2004; Tiger, Hanley, & Heal, 2006). The present study evaluated the effectiveness of, and children's preferences for, two multiple-schedule arrangements in which brief experimenter vocalizations served as discriminative stimuli. Results showed that brief signals were highly effective discriminative stimuli for 3 of the 4 children, and that all children preferred one or both variations of the multiple schedule to a control arrangement. For 1 child, highly discriminated responding was achieved only when continuous signals were introduced.

DESCRIPTORS: signals, choice, concurrent-chains arrangement, multiple-schedule arrangements, preference assessment, preschool

In preschool classrooms, children who recruit their teacher's attention at inappropriate times may disrupt teaching sequences and limit their peers' learning opportunities. Recently, we have described a procedure to promote discrimination of periods in which teacher attention was or was not available (Cammilleri, Tiger, & Hanley, in press; Tiger & Hanley, 2004, 2005; Tiger, Hanley, & Heal, 2006) by including salient visual stimuli correlated with these periods. This procedure, termed a multiple schedule (Ferster & Skin-

ner, 1957), involved teachers wearing one colored lei when their attention was available, and a second colored lei or no lei when their attention was not available. This procedure has been shown to be effective for reducing the ill-timed requesting of both preschool-aged and elementary-aged children during group instruction (Cammilleri et al.).

Our current research efforts are focused on evaluating variations of this multiple-schedule procedure to address practical limitations. For instance, one study found that the presentation of an extinction-correlated stimulus might negatively affect the educational context in which the procedure is implemented (Tiger et al., 2006). In this study, children's preferences for two multiple-schedule arrangements were assessed relative to a control arrangement. In one multiple schedule, an explicit signal was present during both reinforcement (S+) and extinction (S-) periods. In the other multiple

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schedule, an explicit signal was present during reinforcement periods but no explicit signal was present during extinction periods (i.e., the absence of the S+ served as the S-). In the control arrangement, one signal was provided during both reinforcement and extinction periods (i.e., an uncorrelated signal). Four children in this study preferred the S+ only arrangement, suggesting that the S- stimulus had acquired some aversive properties. The inclusion of S- during instructional situations then may evoke avoidance or escape behavior (e.g., children may not attend available instructional opportunities due to the S-).

The use of floral leis as discriminative stimuli also may limit the practicality of the multiple-schedule procedure. Floral leis were selected initially because they were inexpensive, portable, and visually salient from all perspectives. These putative advantages may be overshadowed by the fact that the procedure also requires teachers to have continuous access to one or two discriminative stimuli per student, replace lost or damaged stimuli, and introduce artificial stimuli into the classroom. The use of more naturally occurring discriminative stimuli, such as teacher vocalizations, could obviate these limitations.

The purpose of the present study was to evaluate the effectiveness of multiple schedules in which brief vocal signals were programmed as discriminative stimuli. Based on the results of Tiger *et al.* (2006), we evaluated two variants of this procedure. The first involved the presentation of vocal discriminative stimuli during both reinforcement and extinction periods. The second involved the presentation of a vocal discriminative stimulus during reinforcement periods only. We also assessed children's preferences for these variations as an indicator of the social validity of the procedures. Finally, we compared the effectiveness of the briefly signaled multiple schedule with a continuously signaled multiple schedule for one participant.

## METHOD

### *Participants and Setting*

Participants were selected from a full-day university-based inclusive preschool that served children from 2 years 6 months to 5 years 6 months old of typical and atypical development. At the beginning of the study, Alice was 3 years old, Quincy was 4 years old, Lana was 4 years old, and Trent was 5 years old. Sessions were conducted in a small room designed to simulate classroom periods in which a teacher provided instruction (i.e., children were provided with developmentally appropriate materials while seated across from the experimenter).

### *Procedure*

Each session was conducted using a concurrent-chains design similar to that described by Tiger *et al.* (2006). That is, each session consisted of one initial-link response opportunity, in which a participant stood outside the session room door and selected one of three different colored cards (10 cm by 10 cm), each of which led to a distinct 3-min terminal link, in which a participant sat across from an experimenter in the simulated classroom. In each terminal link, 15-, 30-, and 45-s periods of reinforcement and extinction alternated on time-based schedules. During reinforcement periods, the experimenter diverted his attention from the child (e.g., looked down or away) except when providing a brief statement of attention contingent on each social approach by the child. During extinction periods, the experimenter also diverted his attention but did not respond to any social approach. The three terminal links differed only in regards to discriminative-stimulus presentation. During S+/S- links, the experimenter said, "It is your time" at the onset of each reinforcement period and "It is my time" at the onset of each extinction period. During S+ links, the experimenter said, "It is your time" at the onset of each reinforcement period but did not say anything at the onset of each extinction period.

During mixed links, the experimenter did not say anything at the onset of reinforcement or extinction components. The mixed link allowed evaluation of responding in the absence of schedule-correlated discriminative stimuli (i.e., a control condition for the S+/S- and S+) and identification of children's preferences for the presence (S+/S- and S+) or absence (mixed) of programmed discriminative stimuli.

Each participant experienced two distinct phases during his or her evaluation. The forced-choice phase was designed to assess the relative effectiveness of the S+/S-, S+, and mixed arrangements for promoting discriminated social approaches. During this phase's initial links, the experimenter vocally prompted the child to select specific cards in a random and counter-balanced order, with one or two exposures to each terminal link daily (i.e., a total of three or six sessions were conducted daily). Thus, the three conditions were alternated in a multielement design during this phase. This phase continued until participants engaged in discriminated responding (i.e., elevated responding during reinforcement components relative to extinction components) for six consecutive sessions in one condition. The free-choice phase of the evaluation was designed to assess children's preferences for the three arrangements in the terminal links. During the initial links in this phase, participants were told, "Choose the card you like." Children then experienced the terminal link that was correlated with their selected card. Terminal-link contingencies were identical to those described during the initial phase. An arrangement was considered preferred if (a) it had been selected on six consecutive opportunities or (b) it had been selected on six opportunities more than either of the other two options. After either of these preference criteria were met, the preferred arrangement was removed from the array (e.g., the card associated with the preferred link was removed), such that a preference could then be determined for the remaining two arrange-

ments. The same preference criteria again were applied; the evaluation was terminated following a determination of a preference hierarchy.

A reversal design was used for Alice to compare the relative efficacy of briefly signaled and continuously signaled multiple schedules (similar to those described by Tiger et al., 2006). Sessions were identical to those described above except that during the continuous S+/S- condition, the experimenter wore a red floral lei throughout each reinforcement period and a blue floral lei throughout each extinction period.

#### *Response Measurement and Interobserver Agreement*

During the initial links, card selection was defined as handing a card to the experimenter. During the terminal links, children's social approaches were scored as any vocal (e.g., "Look at what I built") or nonvocal (e.g., waving a hand while making eye contact) behavior directed towards the experimenter.

Interobserver agreement was assessed by having a second observer simultaneously but independently score children's responding during at least 23% of session across participants (range, 23% to 42%). Card selection was never scored in disagreement. Social-approach agreement was determined by using the block-by-block method (i.e., total agreement within 10-s intervals). Mean agreement was 88% for Alice, 91% for Quincy, 98% for Lana, and 99% for Trent.

## RESULTS AND DISCUSSION

Figure 1 depicts participants' responding. All children were observed to engage in discriminated responding during both the S+/S- and S+ conditions when brief vocal stimuli were programmed as discriminative stimuli, with 3 of the 4 children exhibiting near-zero levels of extinction responding under both arrangements, suggesting that brief vocal stimuli during multiple schedules may be a practical and

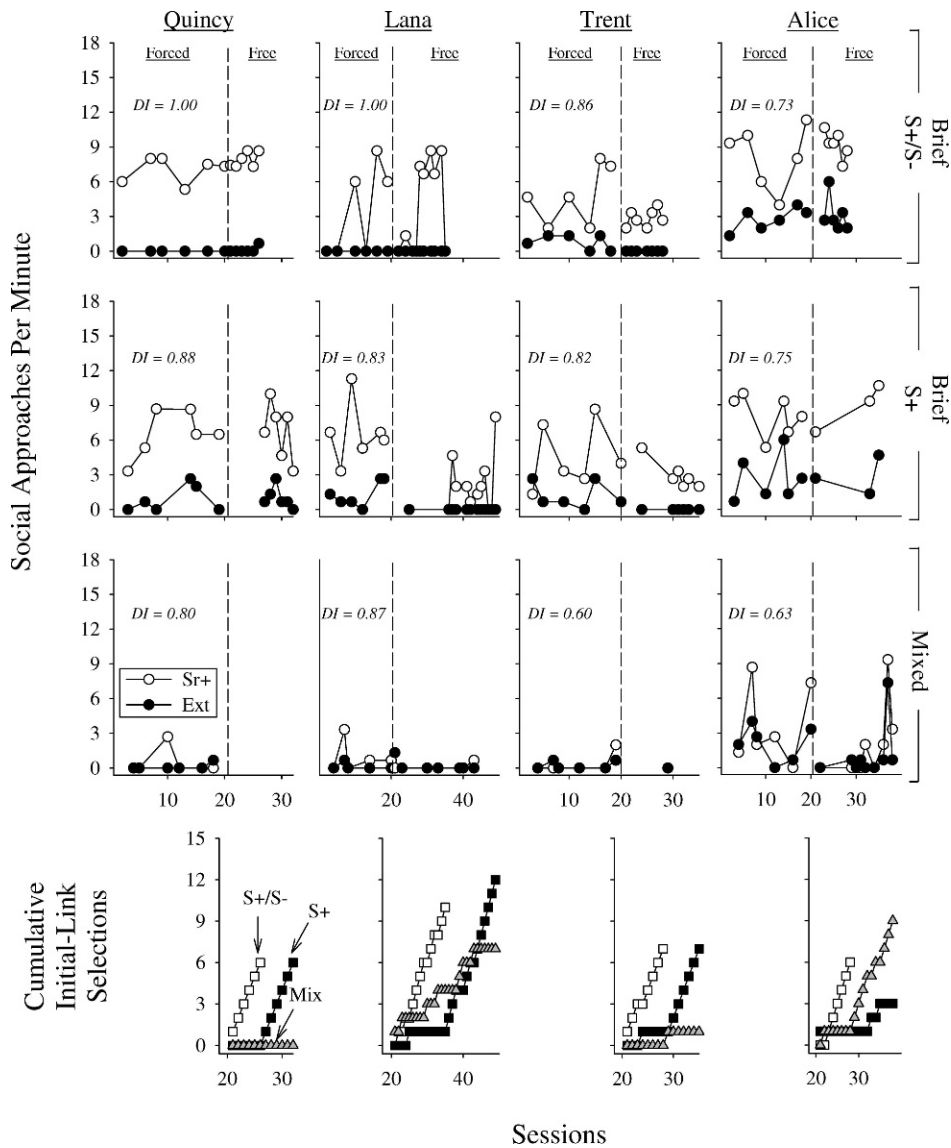


Figure 1. Participants' data are depicted in columns, and each terminal-link arrangement is depicted in the top three rows. Graphs in the top row depict responding under the S+/S- arrangement, graphs in the second row depict responding under the S+ arrangement, and graphs in the third row depict responding under the mixed arrangement. Each graph includes a discrimination index (DI) from the forced-choice phase of the analysis and two data paths, responding during reinforcement (white circles) and extinction (black circles). The bottom row depicts the cumulative initial-link selections during the preference assessment. The point at which a data path stops represents the restriction of that link (i.e., a preference had been identified and that option was no longer presented during the initial links). Terminal-link data were lost for two sessions (Lana, Session 14, S+; Trent, Session 33, S+) due to computer failures.

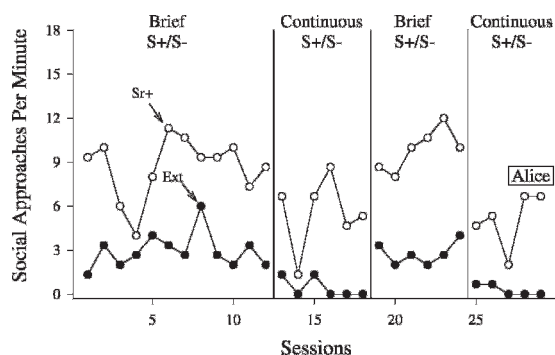


Figure 2. Responding during reinforcement and extinction components of the S+/S- arrangement when component changes were signaled continuously or signaled briefly at the onset of each component change for Alice.

effective alternative to continuous visual stimuli (e.g., floral leis) when arranging multiple schedules. Comparisons of discrimination indexes for the two briefly signaled multiple-schedule variations showed that the S+/S- arrangement was more effective than the S+ only arrangement for 3 of the 4 children. The bottom panel of Figure 1 shows that all 4 children preferred the S+/S- arrangement relative to the S+ only arrangement (i.e., they met preference and restriction criteria for the S+/S- arrangement during the free-choice phase). Because extinction responding persisted for Alice, a continuously signaled multiple schedule was compared to the briefly signaled arrangement (Figure 2) and was found to result in a greater decrease (to zero levels) in responding during extinction.

Several of these findings differ from previous research, albeit in understandable ways. First, Tiger et al. (2006) reported that the continuously signaled S+/S- and S+ resulted in nearly equivalent patterns of discriminated social approaches (i.e., equal discrimination indexes). The differences in the two studies likely can be attributed to the discriminative properties of the offset of the S+. That is, under continuous S+ conditions, the removal of the S+ signaled the onset of an extinction component whereas under the briefly signaled S+ condition, no stimulus change occurred at the onset of an

extinction component; hence, children were more likely to continue responding in the extinction component.

Second, Tiger et al. (2006) reported that 4 of 7 children preferred the S+ multiple schedule relative to the S+/S- multiple schedule. The results of that study suggested that preference for the S+ condition was likely to develop when children had a history of high levels of responding during extinction components relative to reinforcement components (i.e., the history of contacting extinction in the presence of the S- decreased children's preference for the S+/S- condition; see also Mulvaney, Dinsmoor, Jwaideh, & Hughes, 1974; Terrace, 1971). Given that S- stimuli were presented briefly in the present study, it is likely that responding rarely occurred in the presence of the S-; thus, an aversion to the S- probably never developed. It is also possible that the availability of reinforcement was more predictable during the brief S+/S- condition relative to the brief S+ condition, due to the consistent signal at the onset of extinction periods. This increased predictability may have offset any devaluing of the S+/S- condition that resulted from a history of responding during extinction.

Although the brief multiple-schedule procedure resulted in discriminated responding for 3 of 4 children, a continuously signaled multiple schedule was necessary to minimize responding during extinction for Alice. The range of conditions under which continuously presented discriminative stimuli are necessary were not identified in the current study; however, persistent rates of responding during extinction may be one set of conditions in which continuous signals should be considered in lieu of brief signals. In addition, the relative efficacy of and children's preferences for continuous versus briefly presented schedule-correlated stimuli were not evaluated. This represents an interesting area of further research.

The results of the present study suggest that brief multiple schedules may be a suitable and

practical procedure for teaching children when their teacher's attention is or is not available. However, given that the current study was conducted in a simulated classroom by an experimenter, claims regarding the extension of these findings to preschool classrooms are tentative; replications by teachers in typical classroom settings are now needed.

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